Application Of Electrical Resistivity Method In Delineating Geological Boundary In Kakara Village, Kano State, Nigeria

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---ABSTRACT---
  A geophysical study was carried out using Electrical resistivity method *t*o delineated the boundary between basement complex and sedimentary rocks in kakara village, kano state. This area marks a contact zone between basement complex of northern Nigeria and   sedimentary rock of chad basin formation. Twenty four Vertical Electric Soundings (VES) ware carried out within the study area using Geopulse tarameter SAS 300 and a two profiles were created with twelve VES point at each profile. Maximum current electrode separation (AB) of 200m that is (AB/2)=100m,using normal schlumberger electrode configuration. The data obtain from the field was processed using computer software IX1D. The interpreted result was used to produce geologic sections. The result reveal sedimentary rock laying uncomformity on the basement rock with thickness range from 0 to 5m.The result shows considerable agreement with the lithilogical section revealed and borehole data from the near area.

KEY *WORD*: *Vertical electrical sounding, Kakara Village, Geologic section, Resistivity.*

I.   INTRODUCTION
Electrical resistivity survey is based on the principle that the distribution of electrical potential in the ground in the vicinity of an electrode array depends on the electrical resistivity distribution of the surrounding soil and rocks. A direct current was injected into the ground through two current electrode and the variation of the current within the subsurface can be determine through the potential difference between the two other electrode

Mapping a transition zone between the basement complex rock and sedimentary rock can be difficult especially if there is absence of outcrops or any rock section exposure (Bayewu, 2011). However, in Kakara village the presence of quarry sites and erosion help in exposing deeper rock lithology, it gives the idea about the nature of the transition zone,and how to position the sounding profile on the study area in other to get the best subsurface picture of the transition boundary. This study is very importance in any nation economy, since the geological boundary can serve as a trap and for accumulation and concentration of fluids such as petroleum, natural gas and water.

It is also very important in civil engineering as physical and mechanical properties of natural rocks affect the stability of human engineered structure such as dams, buildings and road construction. However detailed study of geological structure gives clue on the geological history of an area.

II.   GEOLOGY OF THE STUDY AREA
The study area lies within a transition zone between sedimentary rock and basement complex rock in the eastern part of Kano. The sedimentary part of the study area is located within the Chad formation in Chad basin, the Lithostatigraphy of this formation is an Argillatious sequence in which impersistance arenecous horizon occur, the clay represent the deposition under less turbulent condition away from the shore of the lake, the sandy sediment are thought to have been laid down as a lake margin deposits or as alluvial fans and deltas (Barber, 1965)

The basement complex is composing mainly of older Granite and Granodiorite. Biotite granite is an acid igneous rock with Biotite mineral while Granodiorite has a composition which is intermediate between a diorite and Granite.

Joint and fractures in the basement complex rocks are better developed in granites and quartzite and less in gneiss and Migmatites, joints rarely extends to a depth greater than 90 meters (Ahmed, 1987)

There is vivid presence of both the basement rock and the sedimentary Chad formation on the surface since part of the study area has been excavated by seasonal rivers and some quarry activities around the study area, there by exposing the Lithological section of both the basement complex and sedimentary rocks.

III.   SITE AREA DESCRIPTION

The study area , Kakara village in Gezawa Local Government Area of Kano State lies on approximately on latitude 12^0 02'N and latitude 12°12'N; and longitude 8^0 65'E and 8° 73'along Gumel – Kano Federal road. The terrain is relatively flat and the area can be accessed by some other motorable roads which are not tarred.

IV.   METHODOLOGY

Measurements were taken along two profiles that are parallel to each other and 100m apart. Station interval of 100m was used to establish various sounding points. Measurements were taken at each vertical electrical sounding point (VES point) by expanding the current electrodes symmetrically about the center of the spread. The maximum depth penetration (also known as depth of penetration) of the AMNB method is 1/3 to ¼ of the maximum distance of AB (Frohlich et al., 1996). That is, the maximum measurement for AB = 70m or 100m in few cases the maximum depth probed is about 18m to 23m. This depth is considered enough to delineate the interface between the two rock types of interest. Measurements were taken starting from AB/2 = 1.5m, 2.0m, 3.0m, 4.5m, 7.0m, 10.0m, 15.0m, 20.0m, 30.0m, 45.0m, 60.0m, 70.0m, 80.0m to 100.0m. At a distance when the potential difference between the potential electrodes becomes too small for the potential to be measured accurately, the potential electrodes (MN) spacing was also increased from 0.5m to 1.0m to obtain a measurable potential.

V.   INTERPRETATION

The Geoelectric sections in fig 2 shows electrical resistivity model which best fits resistivity response along the two profiles. The results of the resistivity sounding were correlated with the lithological longs of nearby boreholes, expose cross section and hand dug wells around the area.

The results obtained from the two profiles are interpreted using computer software IXD to plot the graph. From this graph the Geoelectric section was created which shows clearly the transition zone between the basement complex and the sedimentary complex at various depths across the two profiles. An extremely higher resistivity of 45,217Ωm to 83,003Ωm corresponds to top soil which is in most cases weathered laterite and lower resistivity of 44 Ωm - 90 Ωm, 0.5 Ωm -3.84 Ωm and 366 Ωm - 759 Ωm which correspond to sand, clay and dry sand respectively. All these types of formations are part of lithological sequences of Chad formations.

However moderate resistivity values of 70 Ωm - 500 Ωm correspond to fractured part of the basement complex while the fesh basement complex with higher resistivity values of 500 Ωm – 14,266 Ωm

The wide range of the resistivity value is as a result of varying resistivity characteristics thus showing different resistivity values when measured. The variance normally is as result of water saturation and porosity (matsui, 1993) under any set of moisture condition gravel always have higher resistivity than sand similarly sand has a higher resistivity than silt and silt has higher resistivity than clay(Baines et al. 2002)

VI.   CONCLUSION

Structurally according to the result from the field, the transition zone is nonconformity. That is the younger sedimentary rock unit separated from the basement rock which suggests there was a long term of weathering and erosion which exposes the basement before it was finally buried by the sedimentary rock. The thickness of the sedimentary beds is increasing from VES A1 TO A2 and also VES B1 to B10. The declination of the basement is more pronounce in profile A than profile B.

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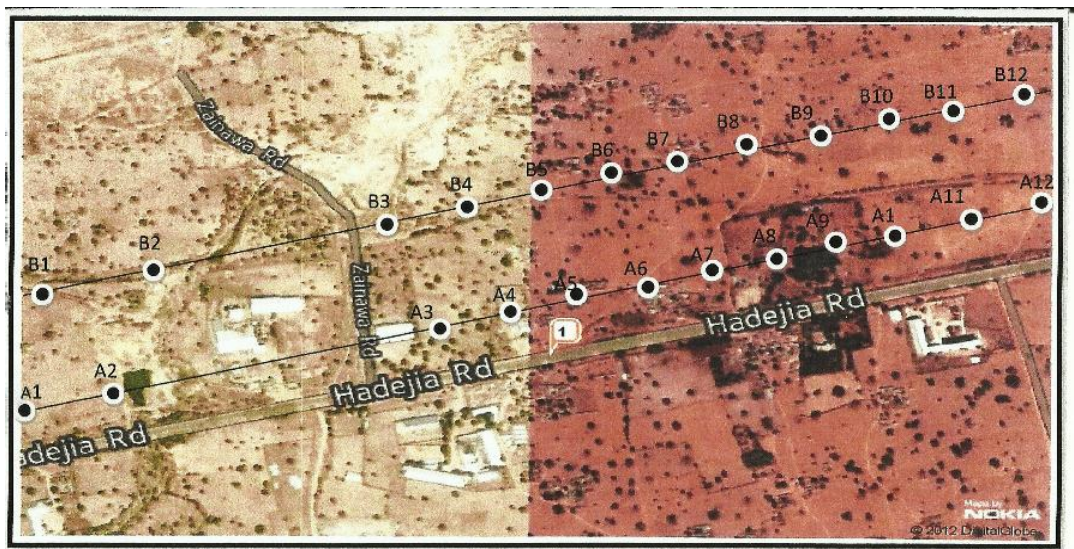

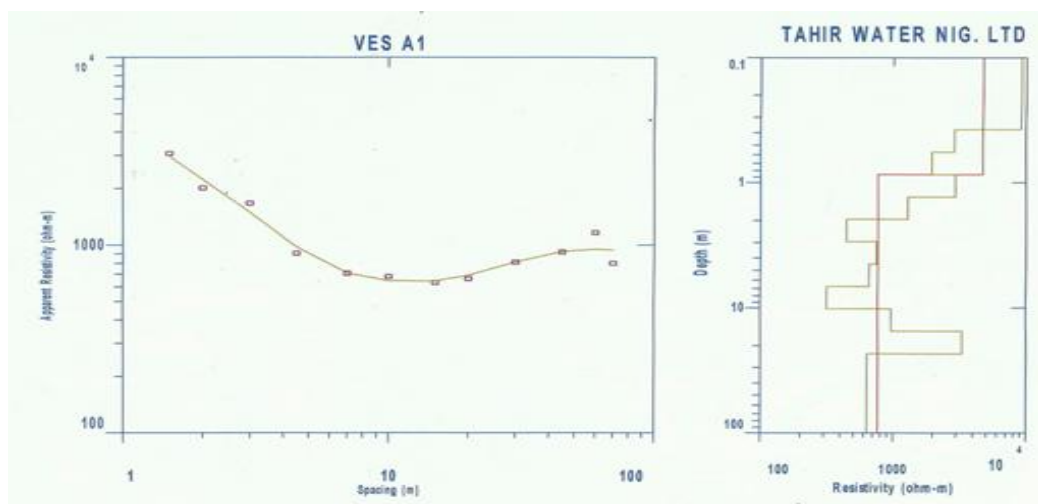Fig:1 Shows the study area showing the two profiles

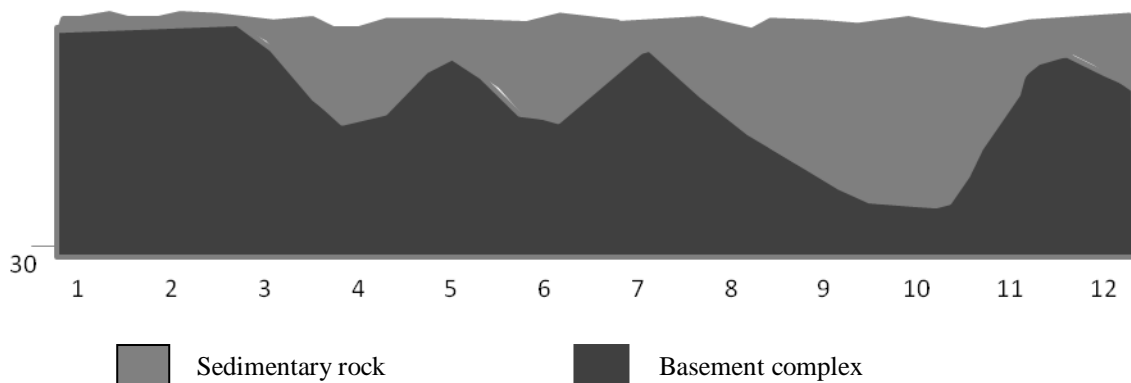Figure 2 A typical resistivity curve and interpreted model for VES station

PROFILE A

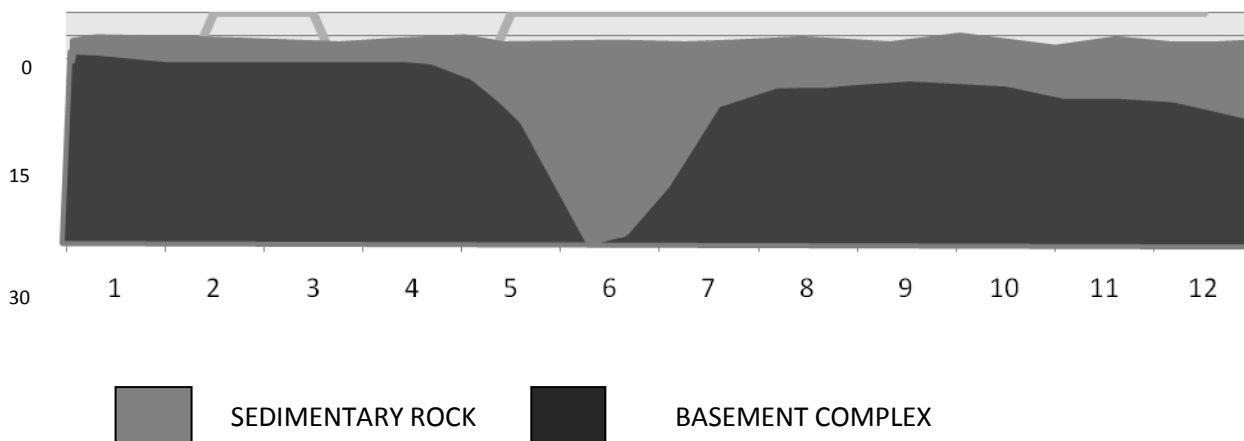Figure: 3 Showing Profile A

PROFILE B

Figure: 4 showing profile B

PROFILE A

Table:1 the interpred model and lithology(profile A)

STATION	LAYER SEQUENCE	RESISTIVITY (Ωm)	THICKNESS (m)	DEPTH (m)	LITHOLOGY
	1	4692.9	0.857	0.857	TOP SOIL
A1	2	767.1			FRACTURED BASEMENT
	1	44.16	0.225	0.225	SAND
	2	210.9	0.788	1.01	FRACTURED BASEMENT
A2	3	502.3			FRESH BASEMENT

Table2 interpreted model and lithology (Profile B)

PROFILE B

STATION	SEQUENCE	RESISTIVITY (Ωm)	THICKNESS (m)	DEPTH (m)	LITHOLOGY
	1	435.02	8.4387	8.4387	FRACTURED BASEMENT
B1	2	555.16			FRESH BASEMENT
	1	79.613	0.21545	0.21545	DRY SAND
B2	2	1458.4			FRESH BASEMENT